ANNUAL REPORT
to the
GOVERNMENTS
of
THE UNITED STATES and CANADA

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

Washington, D.C. Ottawa, Ontario

30 SEPTEMBER, 1967

90-02597/

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

CANADA · UNITED STATES

CANADIAN SECTION
G.M. MacNABB, Chairman
T.R. Johnson, Member

UNITED STATES SECTION
L.A. DUSCHA, Chairman
J.E. Harper, Member

31 December 1987

The Honorable George P. Shultz
The Secretary of State
Washington, D.C.

The Honourable Marcel Masse
Minister of Energy, Mines and Resources
Ottawa, Ontario

Gentlemen:

Reference is made to the Treaty between the United States of America and Canada, relating to co-operative development of the water resources of the Columbia River basin, signed at Washington, D.C., on 17 January 1961.

In accordance with the provisions of Article XV paragraph 2(e), there is submitted herewith the twenty-third Annual Report, dated 30 September 1987, of the Permanent Engineering Board.

The report sets forth results achieved and benefits produced under the Treaty for the period from 1 October 1986 to 30 September 1987.

Respectfully submitted:

For the United States

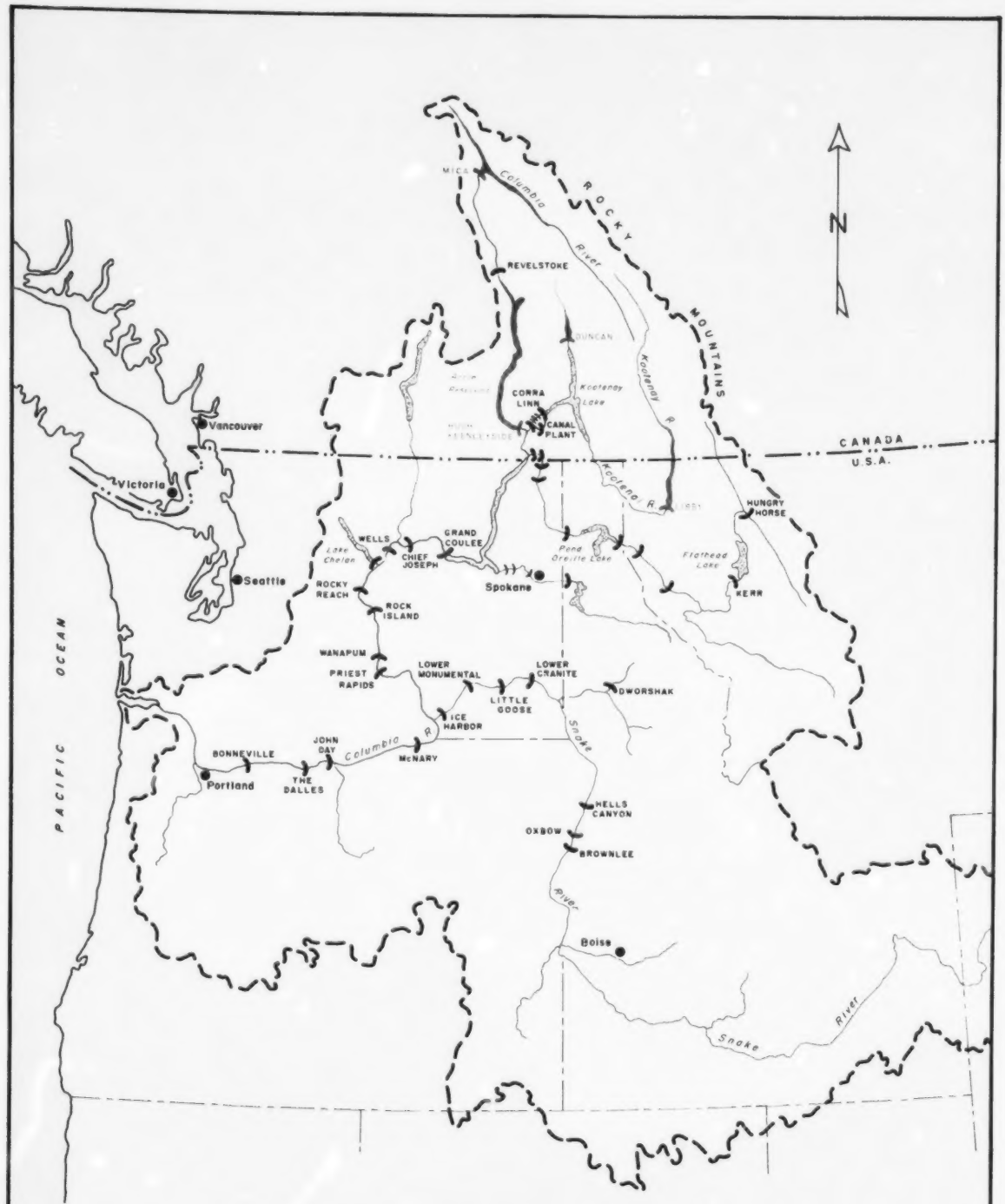
Lloyd A. Duscha, Chairman

J. Emerson Harper

For Canada

G.M. MacNabb, Chairman

T.R. Johnson



COLUMBIA RIVER BASIN

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to the
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COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

Washington, D.C. **Ottawa, Ontario**

30 September 1987

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Photographs supplied by the British Columbia Hydro and Power Authority, the Government of British Columbia, and the U.S. Army Corps of Engineers.

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SUMMARY

The twenty-third Annual Report of the Permanent Engineering Board is submitted to the Governments of the United States and Canada in compliance with Article XV of the Columbia River Treaty of 17 January 1961. The status of projects, progress of Entity studies, operation of Duncan, Arrow, Mica and Libby reservoirs, and the resulting benefits are described.

The Duncan, Arrow, Mica and Libby storage projects were operated throughout the year in accordance with the objectives of the Treaty and the terms of operating plans developed by the Entities. Operations under an agreement between the Entities relating to the use of non-Treaty storage and refill enhancement for Mica and Arrow reservoirs did not conflict with Treaty operations. As a result of low natural flows in the basin, Treaty reservoirs were not required to be operated for flood control purposes during the year. (Pages 27-35)

Studies pertaining to development of the hydrometeorological network and power operating plans are being continued by the Entities to ensure operation of projects in accordance with the terms of the Treaty.

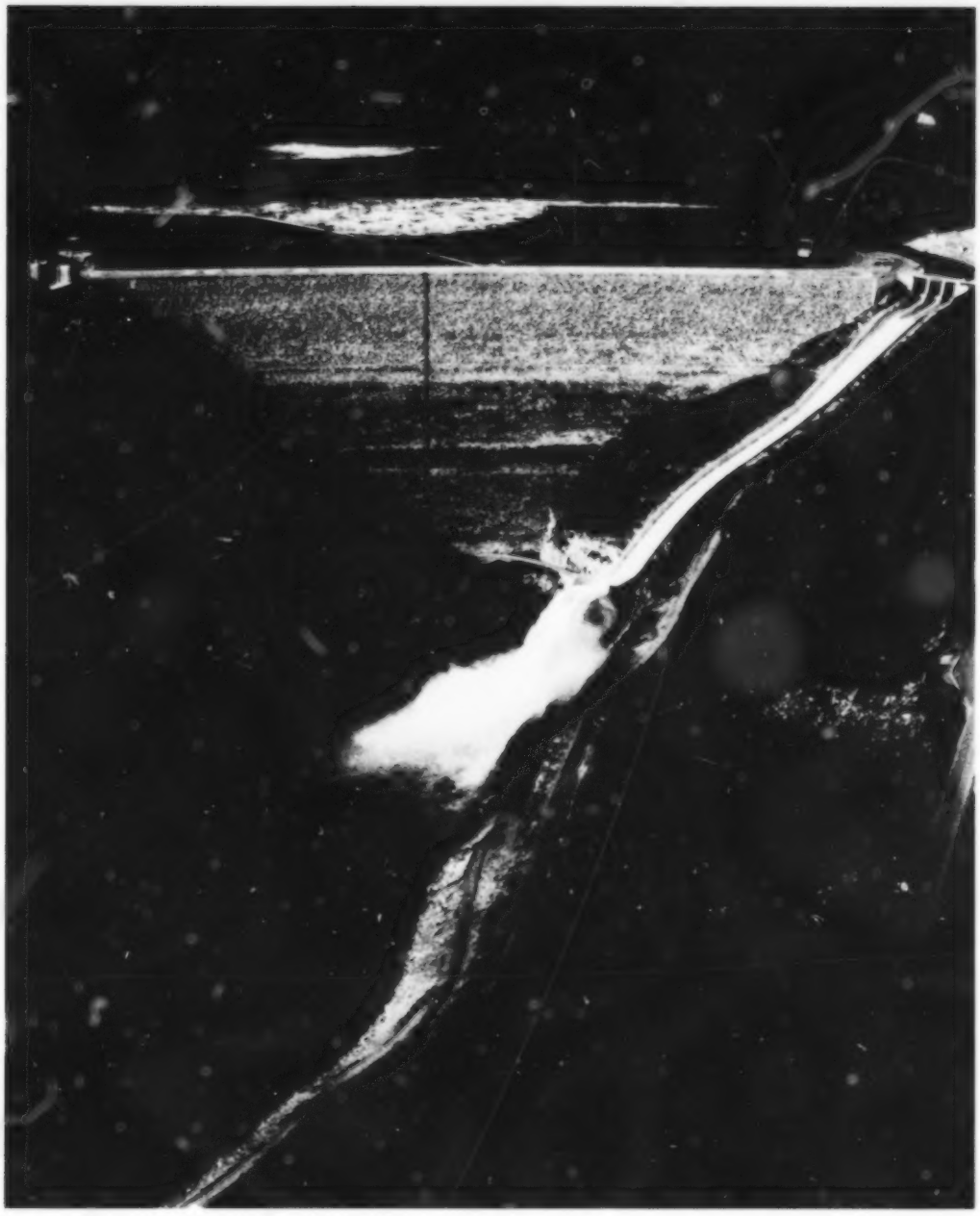
Early in the report year the Board received a report from the Entities on studies of several factors which affect the development of assured operating plans and the calculation of downstream power benefits. Although these studies are continuing, and progress is being made, the Entities have not yet been able to agree on the Board's position that updated streamflows be used in all calculations and have therefore been unable to agree on the Assured Operating Plan and Determination of Downstream Power Benefits for Operating Year 1992-93. (Pages 21-25)

The Board concludes that because of the deficiencies identified in the preceding paragraph the objectives of the Treaty are not being met fully. (Page 37)

INTRODUCTION

The Columbia River Treaty, which provides for cooperative development of the water resources of the Columbia River basin, was signed in Washington, D.C. on 17 January 1961 by representatives of the United States and Canada. Article XV of the Treaty established a Permanent Engineering Board and specified that one of its duties would be to "make reports to Canada and the United States of America at least once a year of the results being achieved under the Treaty . . ."

This Annual Report, which covers the period 1 October 1986 to 30 September 1987, describes activities of the Board, progress being achieved by both countries under the terms of the Treaty, operation of the Treaty projects, and the resulting benefits. Summaries of the essential features of the Treaty and of the responsibilities of the Board and of the Entities are included. The report notes that the Entities are continuing studies to assess the effects of updated streamflow records on the calculation of downstream power benefits and to examine other issues affecting the determination of Assured Operating Plans. Discussion is provided regarding the operations of Treaty reservoirs and of the resulting power and flood control benefits, and conclusions of the Board are presented.



MICA DAM Columbia River, British Columbia
The earth dam with spillway in operation. The underground powerhouse is at the left.

THE COLUMBIA RIVER TREATY

General

The Columbia River Treaty was signed in Washington, D.C. on 17 January 1961 and was ratified by the United States Senate in March of that year. In Canada ratification was delayed. Further negotiations between the two countries resulted in formal agreement by an exchange of notes on 22 January 1964 to a Protocol to the Treaty and to an Attachment Relating to Terms of Sale. The Treaty and related documents were approved by the Canadian Parliament in June 1964.

The Canadian Entitlement Purchase Agreement was signed on 13 August 1964. Under the terms of this agreement Canada's share of downstream power benefits resulting from the first thirty years of scheduled operation of each of the storage projects was sold to a group of electric utilities in the United States known as the Columbia Storage Power Exchange.

On 16 September 1964 the Treaty and Protocol were formally ratified by an exchange of notes between the two governments. The sum of $253.9 million (U.S. funds) was delivered to the Canadian representatives as payment in advance for the Canadian entitlement to downstream power benefits during the period of the Purchase Agreement. On the same date at a ceremony at the Peace Arch Park on the International Boundary the Treaty and its Protocol were proclaimed by President Johnson, Prime Minister Pearson, and Premier Bennett of British Columbia.

Features of the Treaty and Related Documents

The essential undertakings of the Treaty are as follows:

(a) Canada will provide 15.5 million acre-feet of usable storage by constructing dams near Mica Creek, the outlet of Arrow Lakes and Duncan Lake, in British Columbia.

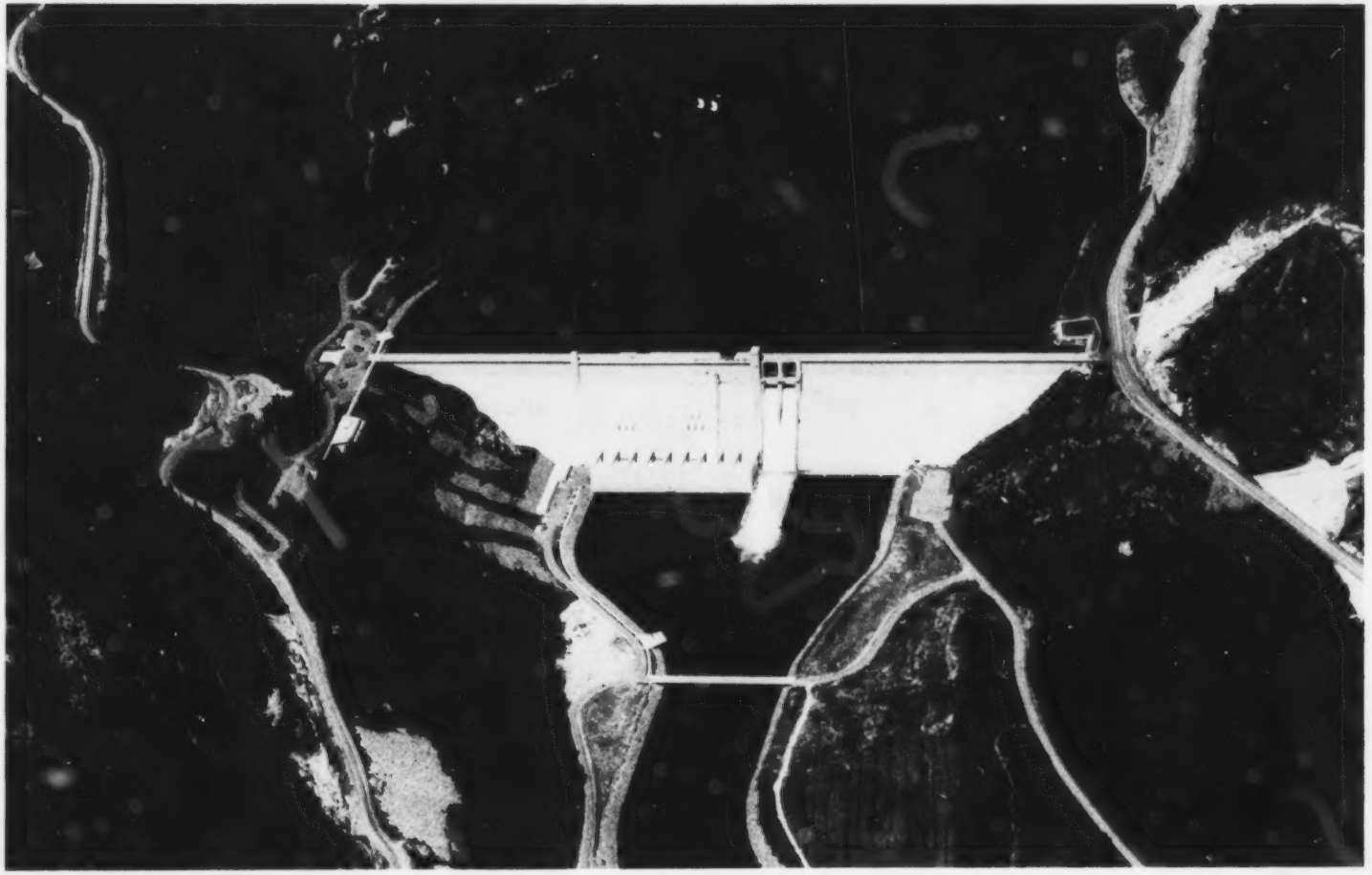
(b) The United States will maintain and operate hydroelectric power facilities included in the base system and any new main-stem projects to make the most effective use of improved streamflow resulting from operation of the Canadian storage. Canada will operate the storage in accordance with procedures and operating plans specified in the Treaty.

(c) The United States and Canada will share equally the additional power generated in the United States as a result of river regulation by upstream storage in Canada.

(d) On commencement of the respective storage operations the United States will make payments to Canada totalling $64.4 million (U.S. funds) for flood control provided by Canada.

(e) The United States has the option of constructing a dam on the Kootenai River near Libby, Montana. The Libby reservoir would extend some 42 miles into Canada and Canada would make the necessary Canadian land available for flooding.

(f) Both Canada and the United States have the right to make diversions of water for consumptive uses and, in addition, after September 1984 Canada has the option of making for power purposes specific diversions of the Kootenay River into the headwaters of the Columbia River.



LIBBY DAM Kootenai River, Montana
The dam and reservoir, Lake Koocanusa. The powerhouse is at the left of the spillway.

(g) Differences arising under the Treaty which cannot be resolved by the two countries may be referred by either to the International Joint Commission or to arbitration by an appropriate tribunal as specified by the Treaty.

(h) The Treaty shall remain in force for at least 60 years from its date of ratification, 16 September 1964.

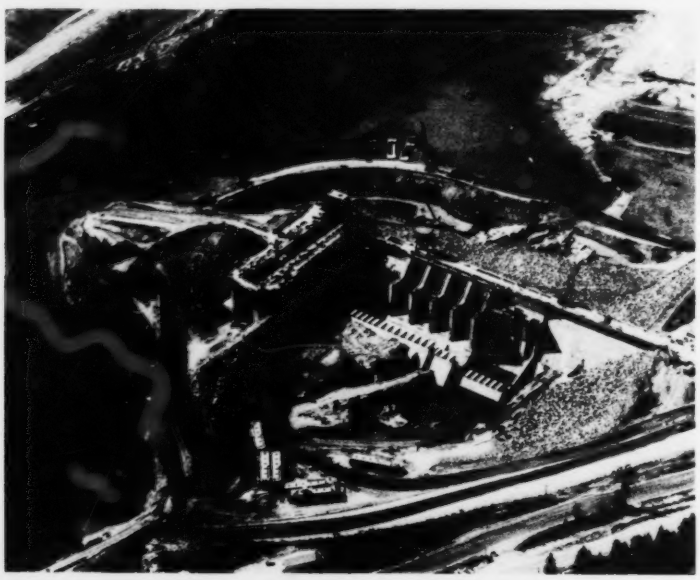
The Protocol of January 1964 amplified and clarified certain terms of the Columbia River Treaty. The Attachment Relating to Terms of Sale signed on the same date established agreement that under certain terms Canada would sell in the United States its entitlement to downstream power benefits for a 30-year period. The Canadian Entitlement Purchase Agreement of 13 August 1964 provided that the Treaty storages would be operative for power purposes on the following dates:

Duncan storage	1 April 1968
Arrow storage	1 April 1969
Mica storage	1 April 1973

PERMANENT ENGINEERING BOARD

General

Article XV of the Columbia River Treaty established a Permanent Engineering Board consisting of two members to be appointed by Canada and two members by the United States. Appointments to the Board were to be made within three months of the date of ratification. The duties and responsibilities of the Board were also stipulated in the Treaty and related documents.



CONSTRUCTION
at Arrow project
during 1967.

Establishment of the Board

Pursuant to Executive Order No. 11177 dated 16 September 1964 the Secretary of the Army and the Secretary of the Interior on 7 December 1964 appointed two members and two alternate members to form the United States Section of the Permanent Engineering Board. Pursuant to the Department of Energy Organization Act of 4 August 1977 the appointments to the United States Section of the Board are now made by the Secretary of the Army and the Secretary of Energy. The members of the Canadian Section of the Board were appointed by Order in Council P.C. 1964-1671 dated 29 October 1964. Each member was authorized to appoint an alternate member. On 11 December 1964 the two governments announced the composition of the Board.

The names of Board members, alternate members and secretaries are shown in Appendix A.

Duties and Responsibilities of the Board

The general duties and responsibilities of the Board to the governments, as set forth in the Treaty and related documents, include:

(a) assembling records of the flows of the Columbia River and the Kootenay River at the Canada-United States of America boundary;

(b) reporting to Canada and the United States of America whenever there is substantial deviation from the hydroelectric and flood control operating plans and if appropriate including in the report recommendations for remedial action and compensatory adjustments;

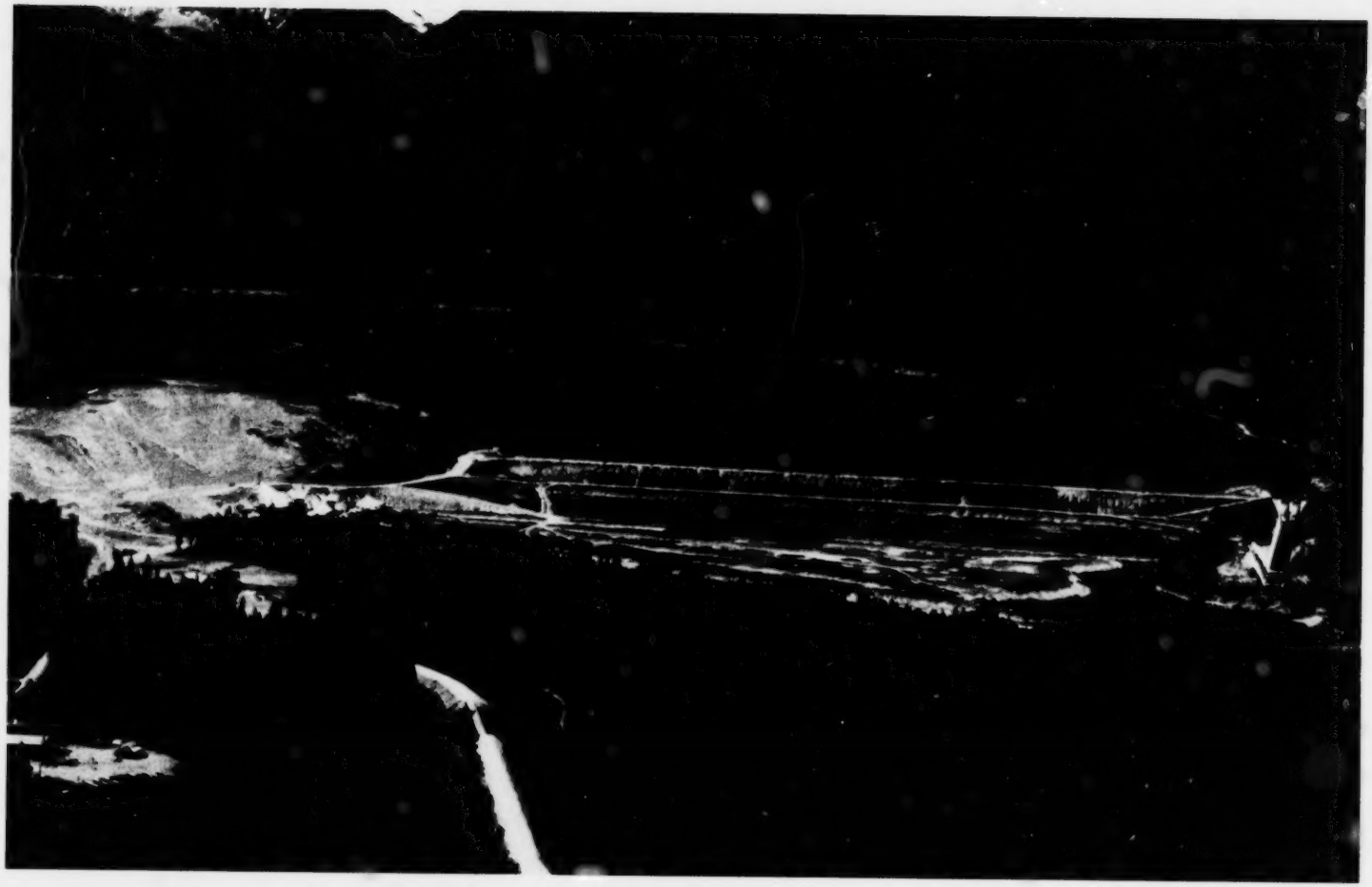
(c) assisting in reconciling differences concerning technical or operational matters that may arise between the entities;

(d) making periodic inspections and requiring reports as necessary from the entities with a view to ensuring that the objectives of the Treaty are being met;

(e) making reports to Canada and the United States of America at least once a year of the results being achieved under the Treaty and making special reports concerning any matter which it considers should be brought to their attention;

(f) investigating and reporting with respect to any other matter coming within the scope of the Treaty at the request of either Canada or the United States of America;

(g) consulting with the entities in the establishment and operation of a hydrometeorological system as required by Annex A of the Treaty.



DUNCAN DAM
The earth dam with discharge tunnels to the left and spillway to the right.

Duncan River, British Columbia

ENTITIES

General

Article XIV(1) of the Treaty provides that Canada and the United States shall each designate one or more entities to formulate and execute the operating arrangements necessary to implement the Treaty. The powers and duties of the entities are specified in the Treaty and its related documents.

Establishment of the Entities

Executive Order No. 11177, previously referred to, designated the Administrator of the Bonneville Power Administration, Department of the Interior, and the Division Engineer, North Pacific Division, Corps of Engineers, Department of the Army, as the United States Entity with the Administrator to serve as Chairman. Pursuant to the Department of Energy Organization Act of 4 August 1977 the Bonneville Power Administration was transferred to the Department of Energy. Order in Council P.C. 1964-1407 dated 4 September 1964 designated the British Columbia Hydro and Power Authority as the Canadian Entity.

The names of the members of the two entities are shown in Appendix B. It is noted that on 1 June 1987 Mr. L.I. Bell succeeded Mr. C.A. Johnson as Chairman of the Canadian Entity and that on 29 August 1987 Major General Mark J. Sisinyak succeeded Major General George R. Robertson as member of the United States Entity.

Power and Duties of the Entities

In addition to the powers and duties specified elsewhere in the Treaty and related documents, Article XIV(2) of the Treaty requires that the entities by responsible for:

(a) coordination of plans and exchange of information relating to facilities to be used in producing and obtaining the benefits contemplated by the Treaty,

(b) calculation of and arrangements for delivery of hydroelectric power to which Canada is entitled for providing flood control,

(c) calculation of the amounts payable to the United States for standby transmission services,

(d) consultation on requests for variations made pursuant to Articles XII(5) and XIII(6),

(e) the establishment and operation of a hydrometeorological system as required by Annex A,

(f) assisting and cooperating with the Permanent Engineering Board in the discharge of its functions,

(g) periodic calculation of accounts,

(h) preparation of the hydroelectric operating plans and the flood control operating plans for the Canadian storage together with determination of the downstream power benefits to which Canada is entitled,

(i) preparation of proposals to implement Article VIII and carrying out any disposal authorized or exchange provided for therein,

(j) making appropriate arrangements for delivery to Canada of the downstream power benefits to which Canada is entitled including such matters as load factors for delivery, times and points of delivery, and calculation of transmission loss,

(k) preparation and implementation of detailed operating plans that may produce results more advantageous to both countries than those that would arise from operation under the plans referred to in Annexes A and B.

Article XIV(4) of the Treaty provides that the two governments may, by an exchange of notes, empower or charge the entities with any other matter coming within the scope of the Treaty.

UNDERGROUND POWERHOUSE at Mica project.

ACTIVITIES OF THE BOARD

Meetings

The Board met in Vancouver, British Columbia on 5 December 1986 to review progress under the Treaty and to discuss preparation of the Board's Annual Report. The Board met with the Entities on the same day to discuss Entity studies and general progress.

On 1 May 1987 in Vancouver, British Columbia, a special technical briefing was provided to the Board by staff of the two Entities. Technical aspects of the Entities' report on Proposed Changes to Assured Operating Plan and Determination of Downstream Power Benefit Studies were explained to the Board.

Reports Received

Throughout the report year the Canadian Entity provided the Board with weekly reports on operation of the Canadian storage reservoirs and with daily flow forecasts during the freshet season for the northern part of the Columbia River basin. The United States Entity provided monthly reports on the operation of the Libby storage reservoir. The Entities also provided the following documents and reports and made copies of computer printouts of studies for the Assured Operating Plan and downstream power benefit calculations available for review:

— Report of Columbia River Treaty Canadian and United States Entities 1 October 1985 through 30 September 1986

— Columbia River Treaty Assured Operating Plan and Determination of Downstream Power Benefits for Operating Year 1991-92, plus a copy of the Entities' agreement on this document

— Detailed Operating Plan for Columbia River Treaty Storage 1 August 1986 through 31 July 1987, plus a copy of the Entities' agreement on this document

— Report on Proposed Changes to Assured Operating Plan and Determination of Downstream Power Benefit Studies.

Subsequent to the end of this report year, the Board received the following documents and reports from the Entities:

— Annual Report of the Columbia River Treaty, Canadian and United States Entities 1 October 1986 through 30 September 1987

— Detailed Operating Plan for Columbia River Treaty Storage 1 August 1987 through 31 July 1988, plus a copy of the Entities' agreement on this document

— Columbia River Treaty Entity Agreement to Study Several Outstanding Issues Concerning The Assured Operating Plan and Determination of Downstream Power Benefit Studies.

Report to Governments

The twenty-second Annual Report of the Board was submitted to the two governments on 31 December 1986.

HUGH KEENLEYSIDE DAM
Concrete spillway and discharge works with navigation lock and earth dam.

Columbia River, British Columbia

PROGRESS

General

The results achieved under the terms of the Treaty include construction of the Treaty projects, development of the hydrometeorological network, annual preparation of power and flood control operating plans, and the annual calculation of downstream power benefits. The three Treaty storage projects in British Columbia, the Duncan, Arrow and Mica projects, produce power and flood control benefits in both Canada and the United States. The Libby storage project provides power and flood control benefits in both countries. In the United States increased flow regulation provided by Treaty projects has facilitated the installation of additional generating capacity at existing plants on the Columbia River. In Canada completion of the Canal Plant on the Kootenay River in 1976, installation of generators at Mica Dam in 1976-77 and the completion of the Revelstoke project in 1984 have caused power benefits to increase substantially. This amounts to some 4,000 megawatts of generation in Canada that may not have been installed without the Treaty. In addition, the installation of generating capacity at Hugh Keenleyside Dam and at the Murphy Creek Site near Trail, British Columbia is planned for the future.

The Treaty provides Canada with the option of diverting the Kootenay River at Canal Flats into the headwaters of the Columbia River commencing in 1984. British Columbia Hydro and Power Authority has completed engineering feasibility and detailed environmental studies of the potential diversion.

The locations of the above projects are shown on Plate 1 in Appendix D.

Status of the Treaty Projects

Duncan Project

Duncan Dam, the smallest Treaty project, was scheduled by the Sales Agreement for operation by 1 April 1968 and was the first of the Treaty projects to be completed. It became fully operational on 31 July 1967, well in advance of Treaty requirements.

The earthfill dam, about 130 feet high, is located on the Duncan River a few miles north of Kootenay Lake. The reservoir behind the dam extends for about 27 miles and provides 1,400,000 acre-feet of usable storage which is all committed under the Treaty. There are no power facilities included in this project.

The project is shown in the picture on page 10 and project data are provided in Table 1 of Appendix D.

Arrow Project

The Hugh Keenleyside Dam, at the outlet of the Arrow Lakes, was the second Treaty project to be completed. It became operational on 10 October 1968 well ahead of the date of 1 April 1969 scheduled by the Sales Agreement. The project at present has no associated power facilities, however, installation of generators is planned for the future.

The dam consists of two main components: a concrete gravity structure which includes the spillway, low-level outlets and navigation lock and an earthfill section which rises 170 feet above the riverbed. The reservoir, about 145 miles long, includes both the Upper and Lower Arrow Lakes, and provides 7,100,000 acre-feet of Treaty storage.

The project is shown in the picture on page 16 and project data are provided in Table 2 of Appendix D.

MICA DAM CONSTRUCTION
during 1967,
looking downstream.

Mica Project

Mica Dam, the largest of the Treaty projects, was scheduled by the Sales Agreement for initial operation on 1 April 1973. The project was declared operational and commenced storing on 29 March 1973.

Mica Dam is located on the Columbia River about 85 miles north of Revelstoke, British Columbia. The earthfill dam rises more than 800 feet above its foundation and creates a reservoir 135 miles long, Kinbasket Lake, with a storage capacity of 20,000,000 acre-feet. The project utilizes 12,000,000 acre-feet of live storage of which 7,000,000 acre-feet are committed under the Treaty.

The underground powerhouse has space for a total of six 434 megawatt units with a total capacity of 2,604 megawatts. The first two generators were placed in service late in 1976 and the last of the initial four units commenced operation in October 1977.

The project is shown in the picture on page 2 and project data are provided in Table 3 of Appendix D.

Libby Project in the United States

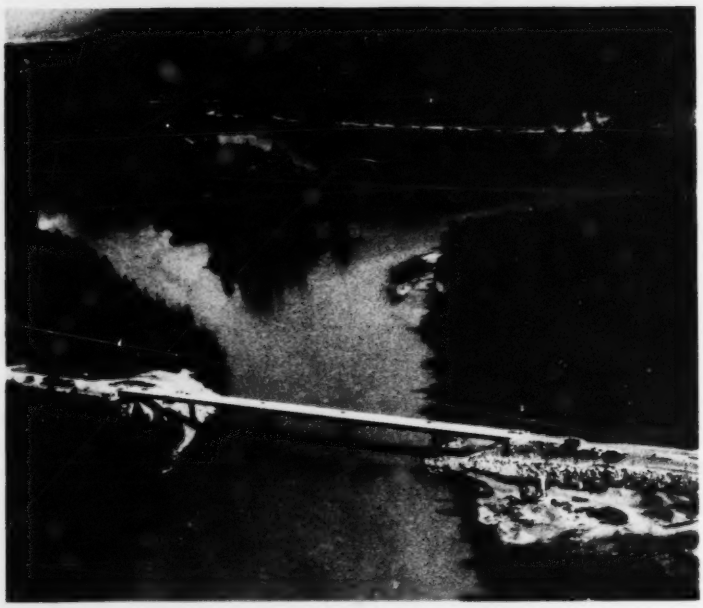
Libby Dam is located on the Kootenai River 17 miles northeast of the town of Libby, Montana. Construction began in the spring of 1966, storage has been fully operational since 17 April 1973, and commercial generation of power began on 24 August 1975, coincident with formal dedication of the project. The concrete gravity dam rises 370 feet above the riverbed and creates Lake Koocanusa which is 90 miles long and extends 42 miles into Canada. Lake Koocanusa has a gross storage of 5,869,000 acre-feet, of which 4,980,000 acre-feet are usable for flood control and power purposes. The Libby powerhouse, completed in 1976, had four units with a total installed capacity of 420 megawatts.

Construction of four additional units was initiated during fiscal year 1978 and the turbines have been installed. However, Congressional restrictions imposed in the 1982 Appropriations Act provide for completion of only one of these units. That unit is in place and the total installed capacity for the five units is 525 megawatts.

There has been no construction activity on the Reregulating Dam since that project was halted by court order in September 1978.

The Libby project is shown in the picture on page 5 and project data are provided in Table 4 of Appendix D.

WARDNER BRIDGE
nearing completion in 1972,
Lake Kookanusa in
British Columbia.



Libby Project in Canada

Canada has fulfilled its obligation to prepare the land required for the 42-mile portion of Lake Koocanusa in Canada. British Columbia Hydro and Power Authority has assumed responsibility for reservoir maintenance and debris clean-up.

Hydrometeorological Network

One of the responsibilities assigned to the Entities by the Treaty is the establishment and operation, in consultation with the Permanent Engineering Board, of a hydrometeorological system to obtain data for detailed programming of flood control and power operation. This system includes snow courses, meteorological stations and streamflow gauges. The Columbia River Treaty Hydrometeorological Committee, formed by the Entities, makes recommendations on further development of the Treaty Hydrometeorological System.

In developing the hydrometeorological network, the Entities, with the concurrence of the Board, adopted a document in 1976 which defines the Columbia River Treaty Hydrometeorological System Network and sets forth a method of classifying facilities into those required as part of the Treaty System and those of value as Supporting Facilities. During the 1976-77 report year, the Entities, with the concurrence of the Board, adopted a plan for exchange of operational hydrometeorological data. That plan is still in force.

In the 1985-86 report year the Entities provided the Board with a report "Revised Hydrometeorological Committee Documents" dated November 1985. The report provides up-to-date listings of the hydrometeorological stations and facilities that constitute the network.

Power Operating Plans

The Treaty and related documents provide that the Entities are to agree annually on operating plans and on the resulting downstream power benefits for the sixth succeeding year of operation. These operating plans, prepared five years in advance, are called Assured Operating Plans. They represent the basic commitment of the Canadian Entity to operate the Canadian Treaty storage and provide the Entities with a basis for system planning. Canada's commitment to operate under an Assured Operating Plan is tied directly to the benefits produced by that plan. At the beginning of each operating year, a Detailed Operating Plan which includes Libby reservoir is prepared on the basis of current resources and loads to obtain results that may be more advantageous to both countries than those which would be obtained by operating in accordance with the Assured Operating Plan.

The Assured Operating Plan for operating year 1991-92, received by the Board early in the report year, includes generation at the Mica and Revelstoke projects in Canada and is based on the operation of the system for optimum generation in both countries. This Plan is essentially the same as the Plan for the preceding operating year.

Early in this report year the Entities provided the Board with the Detailed Operating Plan for Canadian Treaty storage and Libby reservoir for the operating year ending 31 July 1987. The Detailed Operating Plan for the operating year ending 31 July 1988 was forwarded to the Board after the end of the report year. These plans contain criteria for operating the Arrow, Duncan, Mica and Libby reservoirs.

In April 1984, the Entities reached an agreement relating to the initial filling of non-Treaty reservoirs, the use of non-Treaty storage, and Mica and Arrow reservoir refill enhancement. This agreement remained in effect throughout the report year. Operations under the agreement did not interfere with Treaty operations and were consistent with Treaty objectives.

The Northwest Power Planning Council was established by Act of Congress in 1980 to prepare a program for improvement of fish and wildlife in the Columbia River Basin and to develop a conservation and electric power plan for the Pacific Northwest. The Council, on 15 November 1982, adopted the Columbia River Basin Fish and Wildlife Program which establishes a water budget. This budget reserves 3.45 million acre-feet of storage upstream from Priest Rapids Dam on the Columbia River and 1.19 million acre-feet upstream from Lower Granite Dam on the Snake River. This storage is used by United States' project operators when it is required to improve low flows in the main rivers during the downstream migration of anadromous fish. Fisheries and native Indian interests control use of the storage for this purpose. The use of Canadian Treaty storage is advocated by the United States Northwest Power Planning Council in its Fish and Wildlife Program.

During this report year the Entities continued to study factors affecting future development of assured operating plans, including the effect of the water budget. The Board has stated that the assured operating plans are for optimum operation for power and flood control. The Board has also noted, however, that the Entities may agree to provide water for fish migration under detailed operating arrangements providing this does not conflict with Treaty requirements.

LIBBY DAM DOWNSTREAM FACE showing powerhouse and spillway.

Annual Calculation of Downstream Benefits

The general requirements for determination of assured operating plans and downstream power benefits are summarized in the first paragraph of the preceding section.

Paragraph 8 of the Protocol to the Treaty stipulates that a specific 30-year record of streamflows be used for calculating downstream power benefits. The Entities have been using this 30-year record for part of the downstream benefit calculations but have updated and extended the record for general use and have been using the updated record for the specified 30-year period to develop assured operating plans. In its 1984 Annual Report the Board stated that the updated 30-year record should be used to calculate the downstream power benefits as well as to develop the assured operating plans. The Board advised the Entities accordingly and noted that this position should be reflected in the document "Columbia River Treaty, Principles and Procedures for Preparation and Use of Hydroelectric Operating Plans".

In this report year the Entities provided the Board with a copy of their agreed document outlining downstream power benefits resulting from Canadian storage for the operating year 1991-92. Copies of the three computer studies used in the final calculations for the determination of downstream benefits, and which also provide the basis of the hydroelectric operating plan, are available to the Board.

During the 1985-86 report year, the Entities studied several factors which affect the development of assured operating plans and the calculation of downstream power benefits. These factors included the use of updated streamflows and irrigation depletions, shifting and shaping of system loads, and the provision of water budget flows for instream fishery purposes. A report on these additional studies, received by the Board early in this reporting year, indicates that by using revised operating procedures in the development of assured operating plans and in the calculation of downstream benefits to more closely reflect current operation of the United States Columbia River System, increased benefits could accrue to both Canada and the United States. The Entities continued studies during this report year but, by the end of the year, had not reached agreement. The Board has been briefed on these studies by Entity staff and is concerned that some of the changes may not be compatible with Treaty requirements for either the assured operating plans or the calculation of downstream benefits.

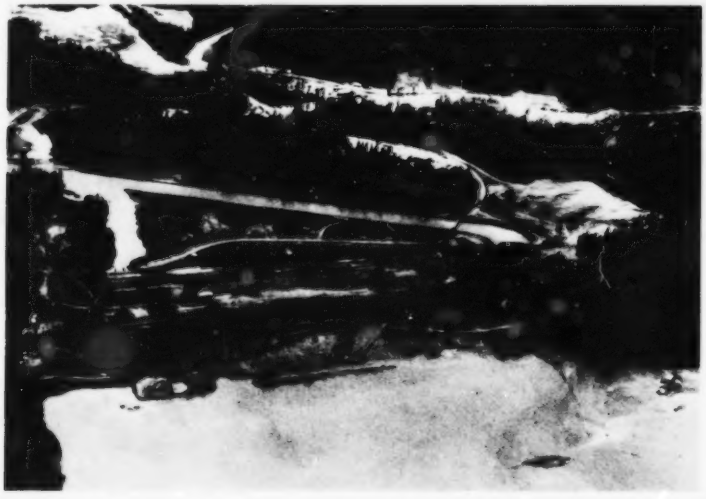
The Board also notes that as of the end of its report year the Entities had not been able to agree on the assured operating plan or the resulting downstream power benefits for the year 1992-93 as is called for by the Treaty. Discussions to this end are continuing and progress is being made. However, the Board is concerned that its previously stated position on the use of updated streamflows has yet to be agreed to by the Entities during the course of these discussions. It notes that calculations of downstream power benefits to be made in 1991-92 for 1997-98 conditions will entail a Canadian power entitlement not covered by the existing Sales Agreement. It is, therefore, important that the Entities, in consultation with the Board, continue their efforts to identify and resolve all matters affecting operating commitments and the calculation of downstream benefits as soon as possible. The Entities have set a target to reach agreements on the assured operating plan and calculation of downstream power benefits for 1992-93 by July of 1988.

Flood Control Operating Plans

The Treaty provides that Canadian storage reservoirs will be operated by the Canadian Entity in accordance with operating plans designed to minimize flood damage in the United States and Canada.

The Columbia River Treaty Flood Control Operating Plan defines flood control operation of the Duncan, Arrow, Mica and Libby reservoirs. This plan was received from the Entities and reviewed by the Board in the 1972-73 report year and is still in effect.

CONSTRUCTION of Duncan Dam during 1967.



Flow Records

Article XV(2)(a) of the Treaty specifies that the Permanent Engineering Board shall assemble records of flows of the Columbia and Kootenay Rivers at the Canada-United States of America boundary. Flows for this report year are tabulated in Appendix C for the Kootenai River at Porthill, Idaho and for the Columbia River at Birchbank, British Columbia.

OPERATION

General

The Columbia River Treaty Operating Committee was established by the Entities to develop operating plans for the Treaty storages and to direct operation of these storages in accordance with the terms of the Entity agreements.

During the report year the Treaty storage in Canada was operated by the Canadian Entity in accordance with:

— Columbia River Treaty Flood Control Operating Plan

— Detailed Operating Plan for Columbia River Treaty Storage 1 August 1986 through 31 July 1987

— Detailed Operating Plan for Columbia River Treaty Storage 1 August 1987 through 31 July 1988

— Columbia River Treaty Hydroelectric Operating Plan, Assured Operating Plan for Operating Year 1986-87

— Columbia River Treaty Hydroelectric Operating Plan, Assured Operating Plan for Operating Year 1987-88.

In addition, the following agreement was in effect during this period:

— An agreement between the Entities dated 9 April 1984 relating to:

  — Agreement between British Columbia Hydro and Power Authority and Bonneville Power Administration Relating to: (1) Initial Filling of Non-Treaty

Reservoirs, (2) The Use of Columbia River Non-Treaty Storage and (3) Mica and Arrow Reservoir Refill Enhancement

— Contract between Bonneville Power Administration and Mid-Columbia Purchasers Relating to Federal and Canadian Columbia River Storage.

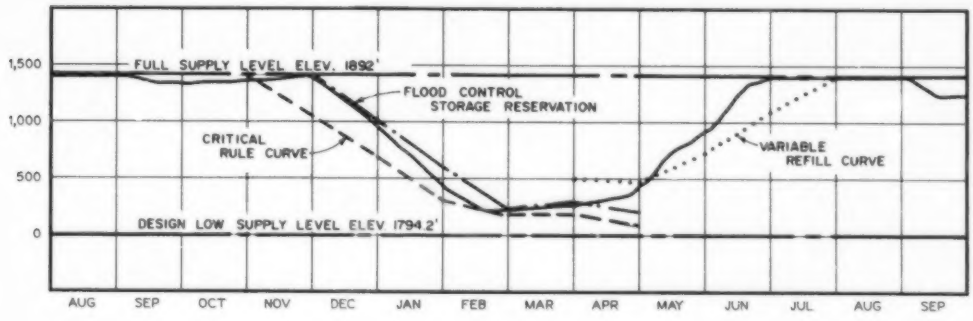
Power Operation

The three Canadian Treaty reservoirs, Duncan, Arrow and Mica, and the Libby reservoir in the United States were in full operation throughout this report year.

All Treaty reservoirs filled during the summer of 1986. At the start of the report year drafting for power operations had begun. Normal drawdown occurred throughout most of the winter with proportional drafting rules in effect part of the time.

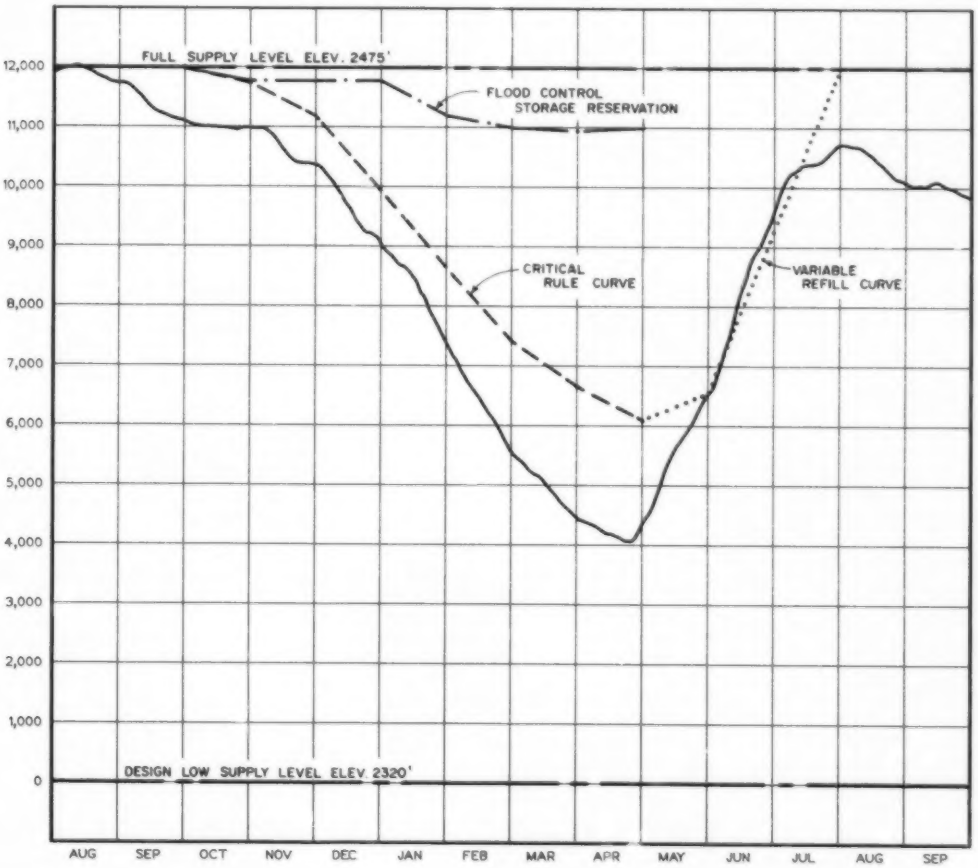
Streamflows in the Columbia River basin were below normal for the entire report year, a direct reflection of the dry conditions throughout the basin. Although the 1987 freshet was well below average, all Treaty storage refilled by the end of July. Some of the Treaty water normally held in Arrow reservoir was retained upstream in Revelstoke reservoir with the result that Arrow reservoir did not reach its full supply level. Mica reservoir also did not reach its full supply level because of empty non-Treaty storage. Drafting had begun at Libby, Duncan and Arrow projects by the end of September.

Storage was transferred between Arrow and Revelstoke storage accounts during the year as permitted under the Entities Storage Agreement of April, 1984. These storage transfers were accomplished without disrupting Treaty operations.



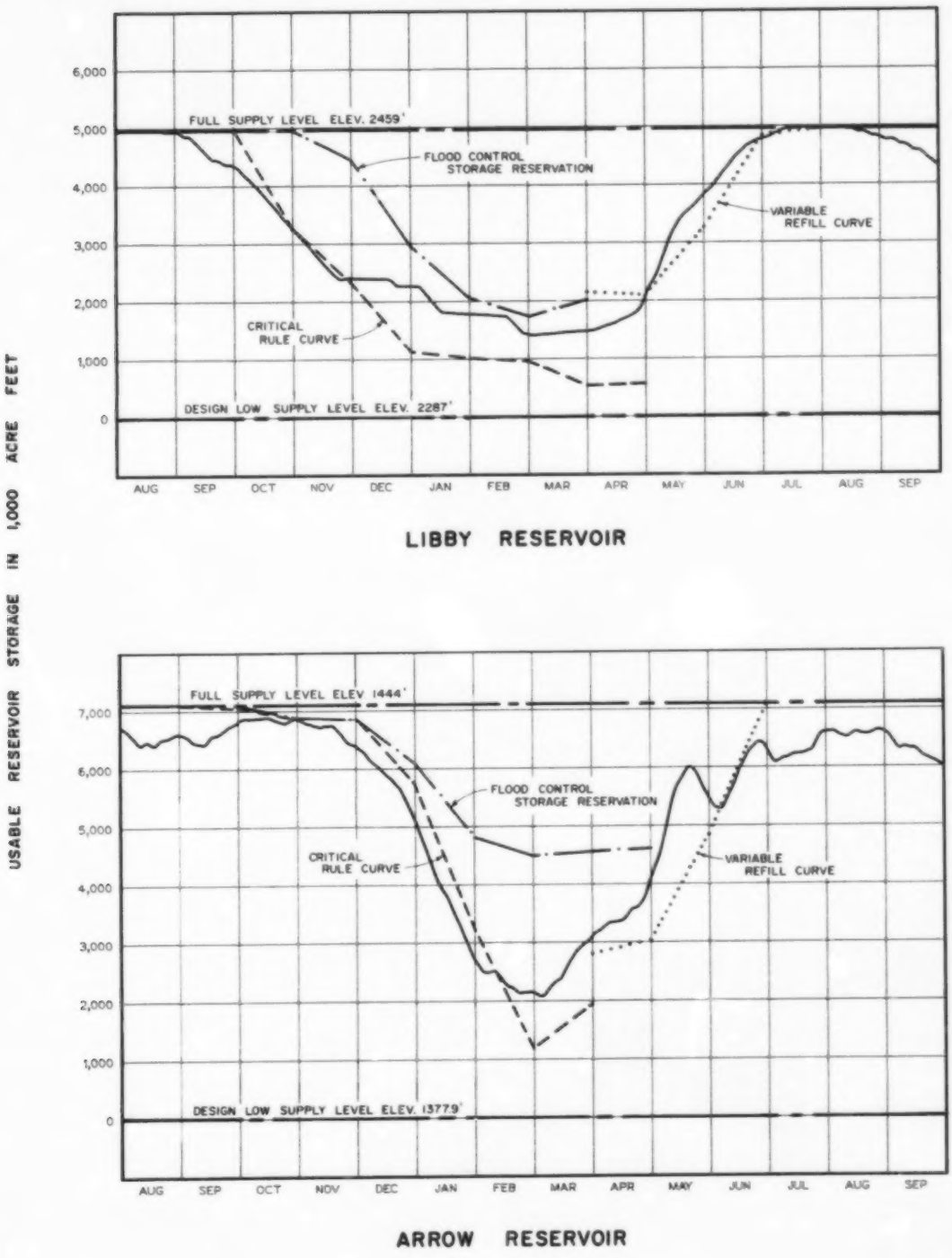
DUNCAN RESERVOIR

USABLE RESERVOIR STORAGE IN 1,000 ACRE FEET



MICA RESERVOIR

HYDROGRAPHS — Duncan and Mica reservoir levels for the 14-month period ending 30 September 1987.



HYDROGRAPHS — Libby and Arrow reservoir levels for the 14-month period ending 30 September 1987.

Commencing in the 1984 report year, operation in the United States incorporated requirements of the Northwest Power Planning Council's Fish and Wildlife Program. This program specifies a water budget for use during the period 15 April to 15 June to meet minimum flow requirements for the downstream migration of anadromous fish. In this report year the water budget of 3.45 million acre-feet for Priest Rapids on the Columbia River was fully utilized between 25 May and 10 June.

Operation of the reservoirs is illustrated on pages 29 and 30 by hydrographs which show actual reservoir levels and some of the more important rule curves which govern operation of the Treaty storages. The Flood Control Storage Reservation curve specifies maximum month-end reservoir levels which will permit evacuation of the reservoir to control the forecast freshet. The Critical Rule Curve shows minimum month-end reservoir levels which should be maintained to enable the anticipated power demands to be met under adverse water supply conditions. The Variable Refill Curve shows reservoir elevations necessary to ensure refilling the reservoir by the end of July with a reasonable degree of confidence. Similar rule curves which apply to operation of the combined Canadian Treaty storages have also been provided to the Board.

NAVIGATION LOCK
in operation at
Hugh Keenleyside Dam.

Duncan reservoir was at elevation 1888.5 feet, three and one-half feet below full pool, at the start of the report year. During October and November the reservoir refilled before drafting began in December to maintain flood control space. Steady drafting continued for downstream power purposes until mid-February when the year's lowest level was reached at 1815.2 feet. Minimum discharge of 100 cfs was released from 21 February until mid-June. The reservoir reached its full pool elevation of 1892 feet on 3 July 1987 and remained full until the end of August. Drafting began again in September and brought the reservoir to elevation 1882.8 feet at the end of the year.

On 1 October 1986, Arrow reservoir was at elevation 1441.5 feet, two and one-half feet below normal full pool elevation. Through October and most of November the reservoir was held above elevation 1440 feet, then in December, drafting resumed to provide flood control space. In January, heavy drafting began for downstream power purposes but by early February, in response to low freshet runoff forecasts, drafting was curtailed to enhance refill. The reservoir reached its lowest level of the year at 1401.1 feet by 6 March 1987.

Refill began on 7 March and continued until 23 May. During the period 24 May to 8 June the reservoir was drafted for downstream requirements. Filling then resumed. By 31 July the reservoir reached elevation 1440.1 feet when, with storage in the Treaty storage account at Revelstoke reservoir upstream, the total Treaty storage was available. Drafting began in September and the reservoir ended the report year at elevation 1435.4 feet.

Mica reservoir began the report year at elevation 2466.4 feet, approximately eight and one-half feet below its full supply level, although the Treaty portion of the storage was full. During October, the reservoir was maintained near elevation 2465 feet. During November through April both Treaty and non-Treaty storage were drafted and by 27 April 1987 the reservoir reached its lowest level of the year at 2388.5 feet.

Inflows to Mica reservoir were above average during May and June due to an early freshet, with a peak of 83,000 cfs occurring on 15 June. Project outflows were held low during this period and the reservoir filled quickly to elevation 2449.2 feet by 30 June. The reservoir reached elevation 2462.6 feet on 2 August, its highest level of the year. This was 12.4 feet below full pool elevation, although Treaty storage was full. During August and September non-Treaty storage was drafted and by the end of September the reservoir was at elevation 2454 feet.

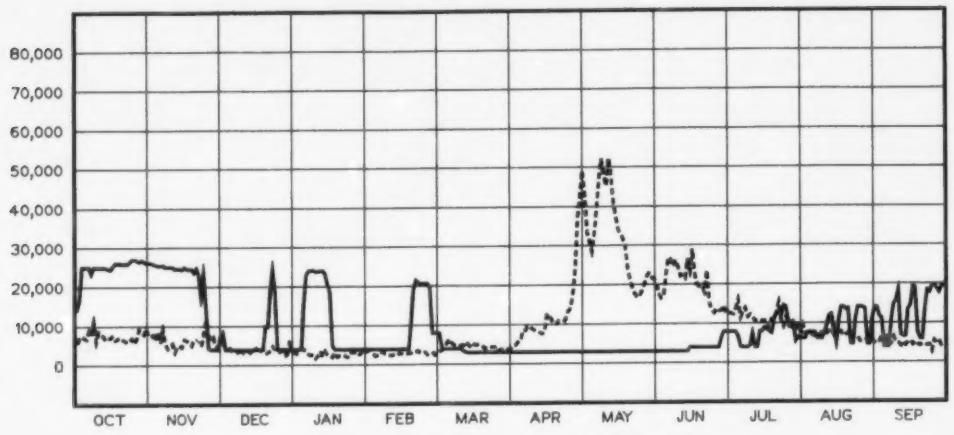
On 1 October 1986, Libby reservoir had begun drafting and had fallen to elevation 2445.2 feet, about fourteen feet below full pool level. Drafting continued at a high rate through October and November. In December outflows were reduced to a minimum to bring the reservoir back to normal levels. Through January and February outflows were variable, then at the end of January when freshet forecasts indicated a low water supply, discharges were again reduced to conserve water. The reservoir reached elevation 2357.7 feet, its lowest level of the year on 4 March 1987.

Inflows began rising in late April and peaked at 52,400 cfs on 13 May, about three weeks earlier than usual. In spite of low freshet inflows the reservoir refilled by 20 July and was held full until 11 August. Drafting occurred through September and the reservoir ended the report year at elevation 2444.5 feet.

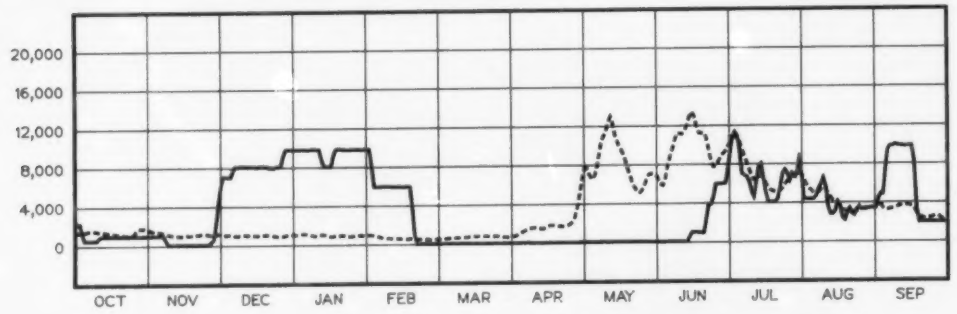
Flood Control Operation

Flood control operation was not necessary in this report year due to very dry conditions in the Columbia River basin and below normal streamflows. Although daily flood control operations were not needed, the reservoirs were operated to provide flood control storage space as required by the Treaty.

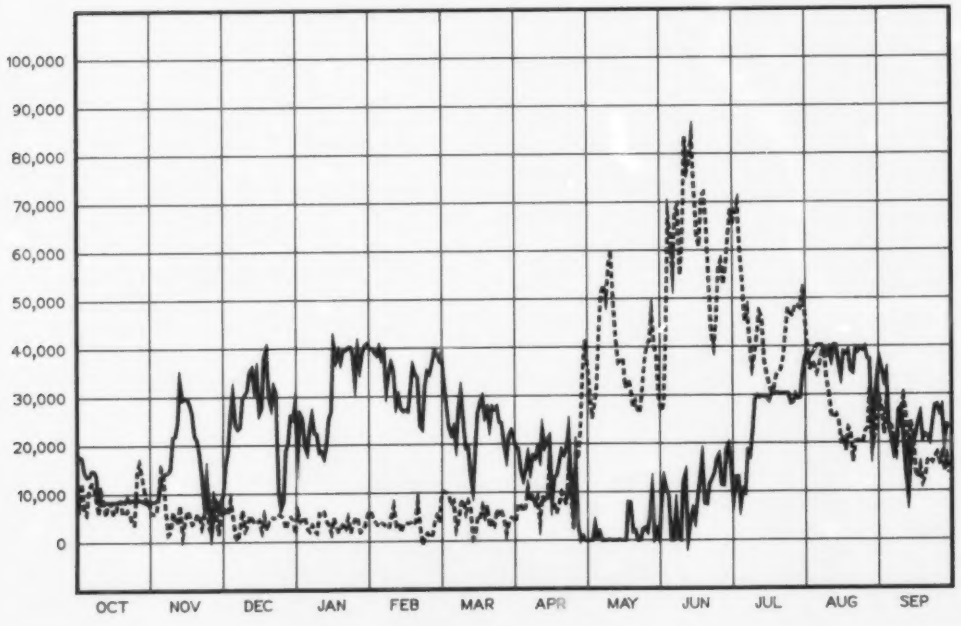
DISCHARGE IN CUBIC FEET PER SECOND



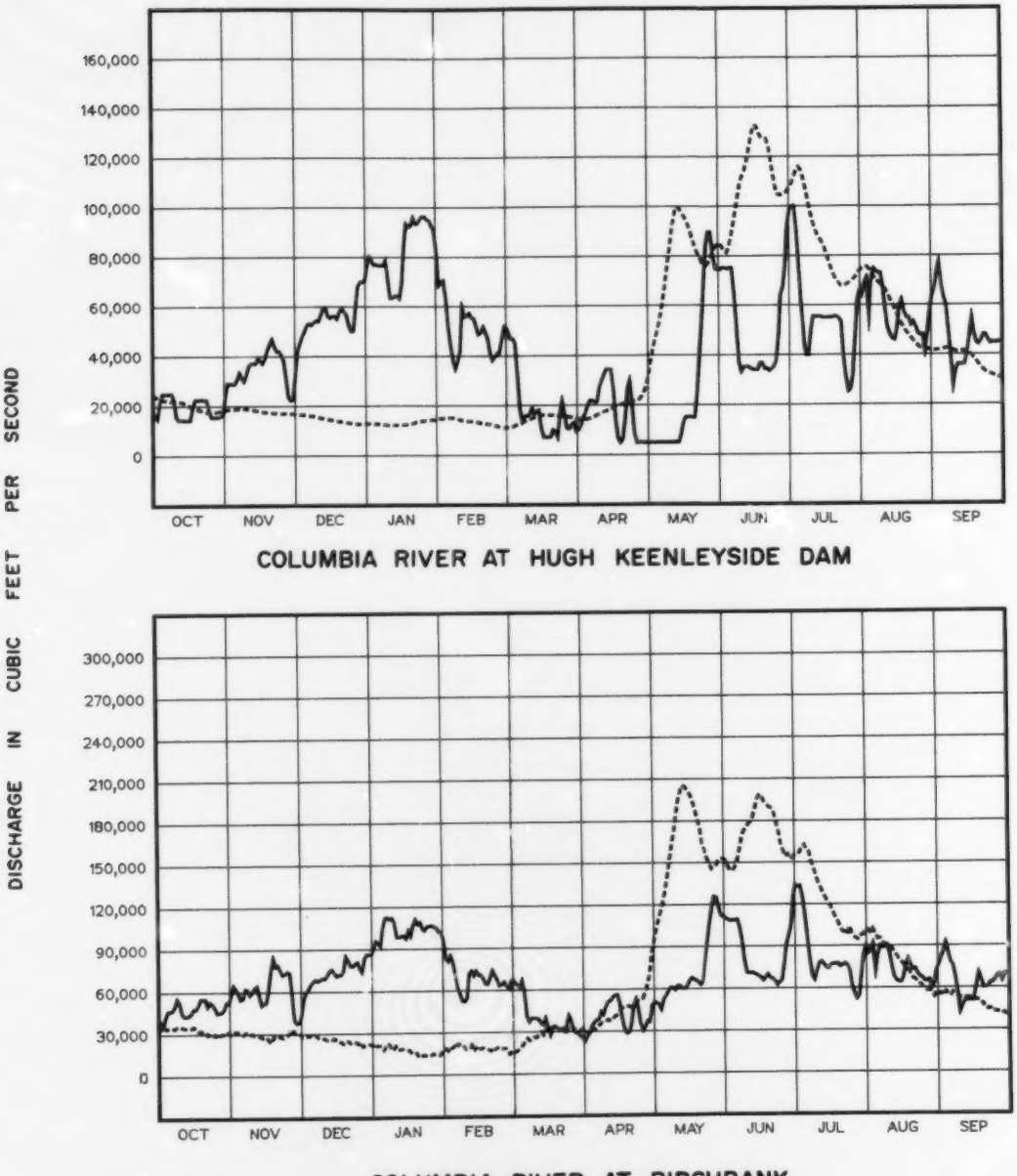
KOOTENAI RIVER AT LIBBY DAM



DUNCAN RIVER AT DUNCAN DAM



COLUMBIA RIVER AT MICA DAM



HYDROGRAPHS — Observed and pre-project flows for year ending 30 September 1987.

BENEFITS

Flood Control Provided

There were no significant flood control benefits this year. Without regulation the 1987 freshet would have resulted in below average peak discharges at Trail, British Columbia and at The Dalles, Oregon and would not have caused flooding.

It is estimated that the Duncan and Libby projects reduced the peak stage on Kootenay Lake by about six feet and that the Duncan, Arrow, Mica and Libby projects reduced the peak stage of the Columbia River at Trail, British Columbia by about six and one-half feet. The effect of storage in the Duncan, Arrow, Mica and Libby reservoirs on flows at the sites and on flows of the Columbia River at Birchbank is illustrated on page 34 by hydrographs which show both the actual discharges and the flows that would have occurred if the dams had not been built. It is noted that the hydrograph showing pre-project conditions for Birchbank has been computed on the assumption that the effects of Duncan, Arrow, Mica and Libby regulation and of the regulation provided by the Corra Linn development on Kootenay Lake have been removed.

The operation of Columbia Basin reservoirs for the system as a whole reduced the natural annual peak discharge of the Columbia River near The Dalles, Oregon from about 439,000 cfs to 284,000 cfs.

All payments required by Article VI(1) as compensation for flood control provided by the Canadian Treaty storage projects have been made by the United States to Canada; the final payment was made on 29 March 1973 when the Mica project was declared operational.

Power Benefits

Downstream power benefits in the United States which arise from operation of the Canadian Treaty storage were pre-determined for the first thirty years of operation of each project and the Canadian one-half share was sold in the United States under the terms of the Canadian Entitlement Purchase Agreement. The United States Entity delivers capacity and energy to Columbia Storage Power Exchange participants as purchasers of the Canadian Entitlement. The benefits of additional generation made possible on the Kootenay River in Canada as a result of regulation provided by Libby, and generation at the Mica and Revelstoke projects, are retained wholly within Canada. The benefits from Libby regulation which occur downstream in the United States are not shareable under the Treaty.

Other Benefits

By agreement between the Entities, as in previous report years, streamflows were regulated for non-power purposes such as accommodating construction in river channels and providing water to assist the downstream migration of juvenile fish in the United States. These arrangements were implemented under the Detailed Operating Plan and provided mutual benefits to the Entities.

SPAWNING CHANNEL
for Kokanee Salmon
near Duncan Dam.

CONCLUSIONS

1. The Duncan, Arrow, Mica and Libby projects have been operated in conformity with the provisions of the Treaty. Operation reflected detailed operating plans developed by the Entities, the flood control operating plan for Treaty reservoirs, and an agreement between the Entities relating to the use of non-Treaty storage and refill enhancement of Mica and Arrow reservoirs. Operation under this agreement did not conflict with normal Treaty operations.

2. The Entities have reached agreement on the detailed operating plan for Columbia River Treaty Storage for 1987-88.

3. Entity evaluations pertaining to development of the hydrometeorological network, power operating plans, and the annual calculation of downstream power benefits are proceeding. However, the assured operating plan and downstream power benefit calculations for operating year 1992-93 have yet to be agreed to by the Entities, nor have the Entities reached agreement on the use of updated streamflows in the calculation of those benefits.

4. Because of the deficiencies identified in item 3 above, the Board must conclude that the objectives of the Treaty are not being met fully.

APPENDIX A

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

United States	Canada
Members	
Mr. Lloyd A. Duscha, Chairman Deputy Director, Engineering & Construction Directorate, Headquarters, U.S. Army Corps of Engineers, Washington, D.C.	Mr. G.M. MacNabb, Chairman R.R. #2, North Gower, Ontario
Mr. J. Emerson Harper Power Marketing Coordination, Department of Energy, Washington, D.C.	Mr. T.R. Johnson 1) Deputy Minister, Ministry of Environment and Parks, Victoria, B.C.
Alternates	
Mr. Herbert H. Kennon 2) Chief, Engineering Division, Headquarters, U.S. Army Corps of Engineers, Washington, D.C.	Mr. E.M. Clark Director, Pacific and Yukon Region, Inland Waters and Lands, Department of the Environment, Vancouver, B.C.
Mr. Thomas L. Weaver Assistant Administrator for Engineering, Western Area Power Administration, Department of Energy, Golden, Colorado	Mr. H.M. Hunt Manager, Power and Special Projects Section, Ministry of Environment and Parks, Victoria, B.C.
Secretaries	
Mr. S.A. Zanganeh Hydraulics & Hydrology Division, Civil Works Directorate, Headquarters, U.S. Army Corps of Engineers, Washington, D.C.	Mr. E.M. Clark Director, Pacific and Yukon Region, Inland Waters and Lands, Department of the Environment, Vancouver, B.C.

1) designated vice Mr. B.E. Marr
2) designated vice Mr. Alex Shwaiko

APPENDIX A

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

Record of Membership

United States		Canada	
Members			
Mr. Wendell E. Johnson 1)	1964-1970	Mr. G.M. MacNabb 1)	1964-
Mr. Morgan E. Dubrow	1964-1970	Mr. A.F. Paget	1964-1973
Mr. John W. Neuberger	1970-1973	Mr. V. Raudsepp	1973-1974
Mr. Joseph B. Caldwell 1)	1971-1973	Mr. B.E. Marr	1974-1987
Mr. Homer B. Willis 1)	1973-1979		
Mr. C. King Mallory	1973-1975		
Mr. Raymond A. Peck, Jr.	1976-1977		
Mr. J. Emerson Harper	1978-		
Mr. Lloyd A. Duscha 1)	1979-		
Alternates			
Mr. Fred L. Thrall	1964-1974	Mr. E.M. Clark	1964-
Mr. J. Emerson Harper	1964-1978	Mr. J.T. Rothwell	1964-1965
Mr. Alex Shwaiko	1974-	Mr. H.M. Hunt	1966-
Mr. Thomas L. Weaver	1979-		
Secretaries			
Mr. John W. Roche	1965-1969	Mr. E.M. Clark	1964-
Mr. Verle Farrow	1969-1972		
Mr. Walter W. Duncan	1972-1978		
Mr. S.A. Zanganeh	1978-		

1) Chairman

APPENDIX B

COLUMBIA RIVER TREATY ENTITIES

United States

Mr. James J. Jura, Chairman

Administrator, Bonneville
Power Administration,
Department of Energy,
Portland, Oregon

Major General Mark J. Sisinyak 2)

Division Engineer,
U.S. Army Engineer Division, North Pacific,
Portland, Oregon

Canada

Mr. L.I. Bell, Chairman 1)

Chairman, British Columbia
Hydro and Power Authority,
Vancouver, B.C.

1) Vice Mr. C.A. Johnson as of 1 June 1987
2) Vice Major General George R. Robertson as of 29 August 1987

APPENDIX C

RECORD OF FLOWS

AT THE

INTERNATIONAL BOUNDARY

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	13,800	27,900	7,620	5,810	5,900	10,400	6,670	32,100	10,600	8,650	7,660	12,600
2	15,200	28,000	12,500	5,670	5,860	9,240	6,690	31,200	9,730	9,040	7,250	14,300
3	15,300	28,000	8,940	5,690	5,770	10,100	7,010	26,100	9,070	9,330	7.060	13,300
4	20,300	27,600	7,350	5,600	5,610	12,400	7,620	21,700	8,720	9,010	7,140	12,700
5	25,200	27,400	7,020	6,780	5,510	10,800	8,540	19,800	8,550	9,100	8,370	11,000
6	26,200	27,200	6,910	18,000	5,540	10,400	9,900	20,200	8,410	8,820	8,430	5,560
7	26,300	27,300	6,720	23,800	5,420	11,500	10,900	21,300	8,370	8,150	8,110	5,080
8	25,800	27,100	6,640	24,900	5,320	11,600	11,600	22,500	8,230	0,420	7,960	5,060
9	25,700	26,900	6,560	25,000	5,330	10,600	12,700	23,300	8,450	6,020	6,650	11,100
10	26,500	26,900	6,460	25,200	5,480	9,650	12,400	23,100	7,980	6,050	6,600	14,500
11	26,600	26,600	6,440	25,200	5,470	9,550	12,600	21,400	7,620	5,680	6,830	17,500
12	26,600	26,700	6,300	25,400	5,480	9,520	12,800	20,200	7,230	6,260	8,280	15,800
13	26,700	26,200	6,230	25,400	5,350	10,200	11,900	19,900	6,910	7,760	10,000	8,090
14	26,700	26,200	6,310	25,400	5,380	11,200	11,100	18,100	6,770	5,540	11,900	7,110
15	26,700	26,000	6,170	22,700	5,380	11,400	10,800	17,000	6,610	5,320	12,300	7,030
16	26,800	25,800	6,170	21,200	5,280	11,000	11,800	16,200	7,120	8,290	8,870	12,700
17	26,900	26,000	6,090	17,500	5,450	10,300	13,700	14,900	7,560	8,610	6,360	16,200
18	27,100	26,100	6,260	7,530	5,420	9,900	15,700	13,700	7,360	9,700	12,800	19,000
19	27,200	26,700	6,160	6,280	5,940	9,810	16,000	12,700	7,220	9,680	14,700	16,500
20	27,300	26,800	7,600	6,030	12,200	9,570	14,500	11,700	7,260	8,690	14,700	8,410
21	27,400	28,000	10,600	5,920	20,200	9,040	13,200	10,900	7,290	9,060	14,400	6,960
22	27,500	28,400	11,400	5,750	21,900	8,610	12,700	10,200	7,140	12,000	13,000	6,940
23	27,500	23,200	21,100	5,770	22,000	8,150	13,400	9,800	6,950	14,100	6,860	15,100
24	27,400	29,100	22,800	5,760	21,800	7,850	14,400	9,660	6,810	13,700	6,070	17,200
25	27,700	35,100	16,700	5,710	21,700	7,580	15,500	9,500	6,520	14,300	12,600	18,800
26	27,800	20,500	7,570	5,700	21,700	7,470	16,200	9,390	6,350	15,100	14,500	19,500
27	28,100	12,000	6,310	5,760	21,900	7,520	16,700	9,330	6,200	13,800	14,700	19,700
28	27,700	9,490	6,080	5,720	17,500	7,340	18,600	9,310	6,270	11,700	14,700	17,900
29	27,700	8,590	6,000	5,510		6,970	23,500	9,080	6,150	11,200	12,900	19,100
30	28,000	8,070	5,750	5,580		6,840	28,700	8,930	7,930	11,100	6,580	19,700
31	28,200		5,810	5,520		6,700		10,200		7,050	5,930	
Mean	25,600	24,700	8,400	12,600	10,200	9,460	13,300	16,600	7,580	9,330	9,810	13,200

KOOTENAI RIVER AT PORTHILL, IDAHO — Daily discharges for the year ending 30 September 1987 in cubic feet per second.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	34,900	57,700	43,600	90,800	82,900	66,500	25,500	48,800	111,000	125,000	89,400	76,700
2	34,100	64,800	55,400	95,700	81,000	67,100	23,100	50,800	111,000	134,000	84,700	81,700
3	35,700	62,100	60,000	94,400	84,900	65,500	26,600	50,200	110,000	133,000	86,600	86,600
4	42,100	59,000	62,000	92,500	80,100	63,400	29,200	48,900	108,000	133,000	91,300	92,300
5	46,600	54,900	65,400	105,000	71,600	61,700	33,900	45,600	109,000	125,000	71,600	85,500
6	46,700	55,600	67,100	112,000	61,800	66,800	36,400	52,800	109,000	112,000	83,400	78,500
7	47,400	62,300	68,500	113,000	57,300	58,100	38,100	55,500	110,000	96,500	90,200	76,300
8	50,300	61,500	67,600	111,000	52,500	41,200	38,800	58,500	104,000	80,200	88,900	67,900
9	55,300	58,000	68,500	112,000	52,300	37,100	44,000	61,100	94,200	68,700	89,400	56,700
10	52,900	60,200	69,600	109,000	54,800	40,000	42,100	60,900	80,700	65,600	90,900	42,600
11	45,200	62,800	69,300	98,500	71,900	40,000	47,700	59,400	71,200	73,100	85,100	47,600
12	43,000	64,200	71,300	98,400	74,000	39,900	51,200	62,100	71,000	78,100	75,500	50,800
13	43,200	57,200	74,700	99,300	70,600	39,200	51,800	62,200	71,300	79,100	67,900	50,700
14	43,400	50,500	75,900	99,600	74,300	36,500	54,400	60,200	70,800	77,100	65,400	50,900
15	44,700	52,000	73,400	97,600	71,000	35,200	55,800	59,900	70,100	74,700	64,100	51,000
16	48,000	52,200	71,000	103,000	71,100	40,000	56,100	61,800	68,700	74,300	64,200	53,500
17	48,100	62,100	71,800	99,400	68,500	33,200	50,300	65,500	67,700	76,700	68,100	61,700
18	50,900	74,900	72,200	106,000	64,700	27,600	40,000	67,700	65,700	77,400	76,700	70,700
19	55,100	83,900	74,600	111,000	64,200	33,500	31,500	66,600	68,300	77,100	80,800	66,000
20	55,000	78,100	85,000	108,000	69,400	33,800	28,600	66,000	70,200	77,600	76,000	59,900
21	55,200	79,000	82,100	109,000	74,600	32,600	29,500	64,500	67,300	75,600	73,200	60,100
22	50,000	75,300	78,500	104,000	70,900	31,900	34,900	63,000	66,600	76,400	73,700	60,800
23	52,800	72,200	77,900	103,000	67,400	32,100	48,200	65,100	65,000	77,700	69,900	63,400
24	51,400	72,800	79,900	106,000	63,400	30,500	52,800	79,700	62,500	76,200	68,200	63,700
25	49,000	74,600	80,900	106,000	64,300	33,500	46,600	92,700	64,400	72,400	67,200	65,800
26	45,100	73,600	76,500	107,000	66,100	41,600	35,100	106,000	65,600	61,400	64,900	68,400
27	45,600	57,700	73,300	105,000	63,400	37,700	30,500	117,000	77,200	55,700	65,100	69,400
28	46,000	39,500	83,600	105,000	61,000	30,800	33,200	126,000	91,400	52,400	65,600	65,000
29	48,100	37,500	86,200	102,000		29,300	37,400	125,000	97,800	54,800	60,000	69,600
30	52,700	38,300	86,300	102,000		28,600	36,600	118,000	105,000	71,400	63,700	70,000
31	52,200		86,200	95,900		27,000		112,000		84,300	72,700	
Mean	47,400	61,800	72,800	103,000	68,200	41,400	39,700	72,000	83,500	83,800	75,300	65,500

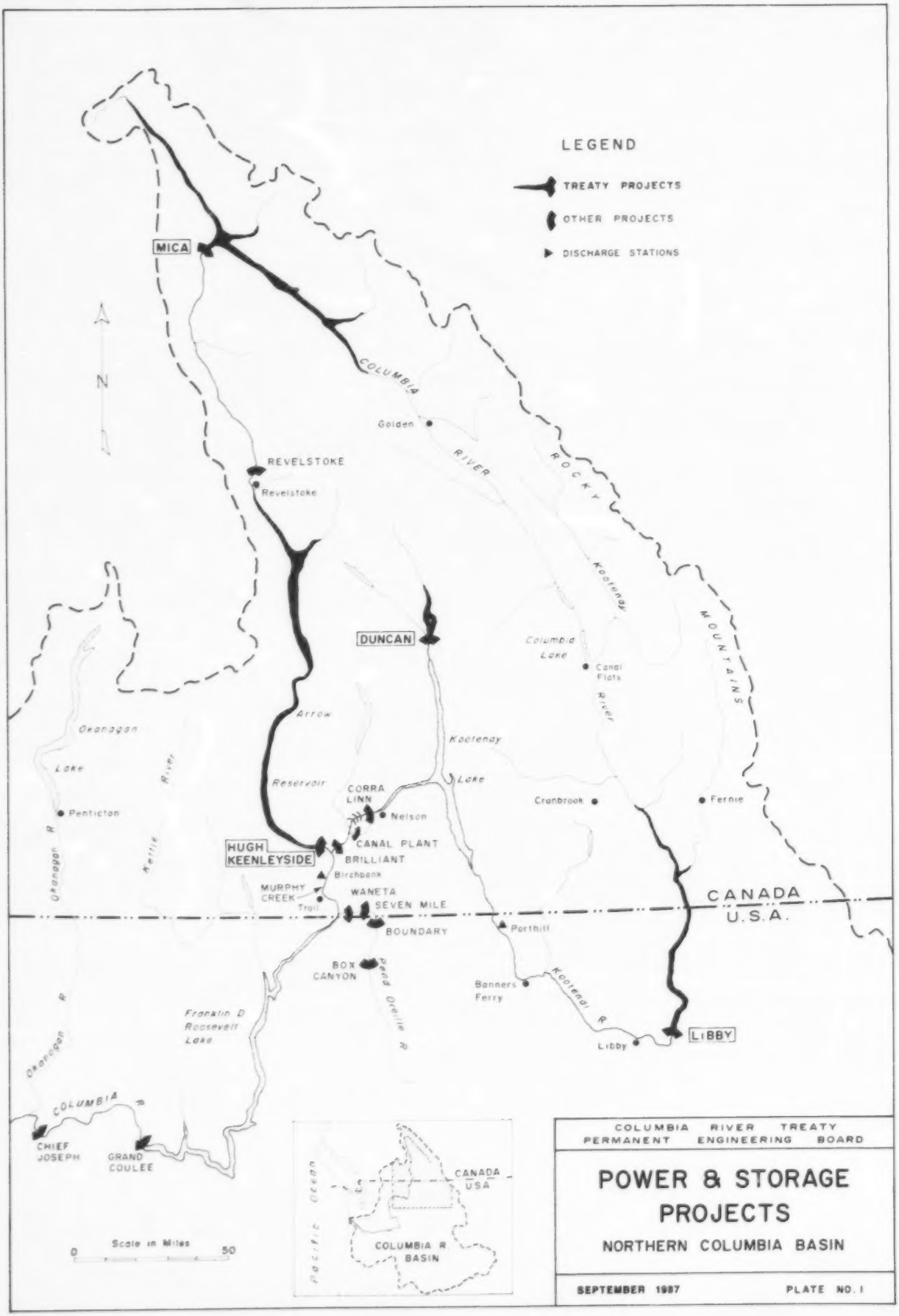
COLUMBIA RIVER AT BIRCHBANK, B.C. — Daily discharges for the year ending 30 September 1987 in cubic feet per second.

APPENDIX D

PROJECT INFORMATION

Power and Storage Projects,
Northern Columbia Basin — Plate No. 1

Project Data
Duncan Project — Table No. 1
Arrow Project — Table No. 2
Mica Project — Table No. 3
Libby Project — Table No. 4



COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

POWER & STORAGE PROJECTS

NORTHERN COLUMBIA BASIN

SEPTEMBER 1987 PLATE NO. 1

TABLE 1

DUNCAN PROJECT

Duncan Dam and Duncan Lake

Storage Project	
Construction began	17 September 1964
Storage became fully operational	31 July 1967
Reservoir	
Normal Full Pool Elevation	1,892 feet
Normal Minimum Pool Elevation	1,794.2 feet
Surface Area at Full Pool	18,000 acres
Total Storage Capacity	1,432,500 ac-ft
Usable Storage Capacity	1,400,000 ac-ft
Treaty Storage Commitment	1,400,000 ac-ft
Dam, Earthfill	
Crest Elevation	1,907 feet
Length	2,600 feet
Approximate height above riverbed	130 feet
Spillway — Maximum Capacity	47,700 cfs
Discharge Tunnels — Maximum Capacity	20,000 cfs
Power Facilities	
None	

TABLE 2

ARROW PROJECT

Hugh Keenleyside Dam and Arrow Lakes

Storage Project	
Construction began	March 1965
Storage became fully operational	10 October 1968
Reservoir	
Normal Full Pool Elevation	1,444 feet
Normal Minimum Pool Elevation	1,377.9 feet
Surface Area at Full Pool	130,000 acres
Total Storage Capacity	8,337,000 ac-ft
Usable Storage Capacity	7,100,000 ac-ft
Treaty Storage Commitment	7,100,000 ac-ft
Dam, Concrete Gravity and Earthfill	
Crest Elevation	1,459 feet
Length	2,850 feet
Approximate height above riverbed	170 feet
Spillway — Maximum Capacity	240,000 cfs
Low Level Outlets — Maximum Capacity	132,000 cfs
Power Facilities	
None	

TABLE 3

MICA PROJECT

Mica Dam and Kinbasket Lake

Storage Project	
Construction began	September 1965
Storage became fully operational	29 March 1973
Reservoir	
Normal Full Pool Elevation	2,475 feet
Normal Minimum Pool Elevation	2,320 feet
Surface Area at Full Pool	106,000 acres
Total Storage Capacity	20,000,000 ac-ft
Usable Storage Capacity	
Total	12,000,000 ac-ft
Commitment to Treaty	7,000,000 ac-ft
Dam, Earthfill	
Crest Elevation	2,500 feet
Length	2,600 feet
Approximate height above foundation	800 feet
Spillway — Maximum Capacity	150,000 cfs
Outlet Works — Maximum Capacity	37,400 cfs
Power Facilities	
Designed ultimate installation	
6 units at 434 mw	2,604 mw
Power commercially available	December 1976
Presently installed	
4 units at 434 mw	1,736 mw
Head at full pool	600 feet
Maximum Turbine Discharge	
of 4 units at full pool	38,140 cfs

TABLE 4

LIBBY PROJECT

Libby Dam and Lake Koocanusa

Storage Project	
Construction began	June 1966
Storage became fully operational	17 April 1973
Reservoir	
Normal Full Pool Elevation	2,459 feet
Normal Minimum Pool Elevation	2,287 feet
Surface Area at Full Pool	46,500 acres
Total Storage Capacity	5,869,000 ac-ft
Usable Storage Capacity	4,980,000 ac-ft
Dam, Concrete Gravity	
Deck Elevation	2,472 feet
Length	3,055 feet
Approximate height above riverbed	370 feet
Spillway — Maximum Capacity	145,000 cfs
Low Level Outlets — Maximum Capacity	61,000 cfs
Power Facilities	
Designed ultimate installation	
8 units at 105 mw	840 mw
Power commercially available	24 August 1975
Presently installed	
5 units at 105 mw	525 mw
Head at full pool	352 feet
Maximum Turbine Discharge	
of 5 units at full pool	26,500 cfs